DUODENAL DIVERTICULA*

R. HAROLD LOCKHART

The subject of duodenal diverticula is one which is of great interest not only to the radiologist, but to the internist and surgeon as well. This condition, while considered rare, has been recognized for many years, and more especially since the advent of gastro-intestinal roentgenology.

The history of duodenal diverticula, in regard to the knowledge of the subject, is divided by Andrews[1] into two periods: the first is called the "mortuary period", and extended from 1710 to 1910. During this period, Chomel[5], in 1710, was the first to mention a duodenal diverticulum. Morgagni[25] offered the next description in 1839. Habershon described the condition in 1857, Klebs in 1869, Roth[39] in 1872, Herschel and Good[12] in 1880, Seippel[35] in 1895, and Le-Tulle[17] in 1898. Linsmayer[20] reported 1367 necropsies which yielded 45 cases, or 3 per cent, of duodenal diverticula. The literature has been reviewed by Andrews[1], Moore[29], Cole and Roberts[6], Downes[7], Ritchie and McWorther[33], Hartung[11] and others. Less than 100 cases had been reported up to 1910, and of these none had been diagnosed prior to operation or autopsy.

The second period, the "Roentgen ray period", opened when investigators began to throw new light on the pathology of duodenal diverticula *in vivo*. Bauer[2] in 1912 evaluated the clinical symptoms, and Case[4] in 1913 reported four cases found in routine gastro-intestinal Roentgen ray examinations. Larimore and Graham[16] state that from the report of the first case in 1710 to 1910 the condition was only discovered postmortem or at operation, and was considered rare. From 1910 to 1915, descriptions of the condition became more frequent, due to the increasing use of the Roentgen ray in examination of the gastro-intestinal tract. From the available figures, no accurate estimate of the incidence is possible, but it is probably not much over 1 per cent. Penhallow[31] reviewed 2,200 gastro-intestinal Roentgen ray examinations, and 26, or 1.2 per cent, resembled duodenal diverticula. In reviewing the past 500 gastro-intestinal series of our own, we have found 8 cases of duodenal diverticula, or 1.6 per cent. Nagel[27] stated in 1925 that the incidence of duodenal diverticula was

*From the Department of Radiology, Yale University School of Medicine.

2.2 per cent of the necropsies at the Mayo Clinic over a period of one and one-half years. Duodenal diverticula occur more frequently in women than in men, according to Downes[7]. The average age in Case's[4] series is given as 56, although no conclusions can be drawn from these figures as to the probable presence of the condition prior to the time the patient consulted the roentgenologist.

Anatomical Description. Duodenal diverticula are most commonly found in the second portion of the duodenum close to the ampulla of Vater. Most of them arise from the inner and posterior surface of the gut, and are supported by the surrounding structures. The walls of most of the pouches, especially if of any size, are composed of mucosa, submucosa and a thinned-out muscularis mucosa, which may or may not be covered by peritoneum, according to the location. The glands of Lieberkuhn and the glands of Brunner may or may not be present in the wall of a diverticulum. Cole's[6] study revealed the presence of a diverticulum in the first portion of the duodenum in only 3 per cent of cases, and a smaller percentage was found in the third portion and in the jejunum. According to Cole, bits of pancreatic tissue are frequently found in the mucosa of the diverticulum. Some of the diverticula in the third portion of the duodenum have been found at operation to be buried in the pancreas.

Duodenal diverticula have been classified as acquired or congenital. Butler and Ritvo[3] have noted that in the acquired type, the muscular layer is usually entirely absent, or present only as a ring at the mouth of the sac, whereas in the true or congenital type, the layers of the duodenum are intact; that is, the mucosa, submucosa and muscular layers, except in the case of a very large diverticulum where the muscularis has not been stretched, suffice to cover the entire sac. A congenital diverticulum is classified as false when the muscular layer is lacking. The true and false congenital types arise as pouches from the enteric tube as it rotates to the right to form the duodenal loop, and in explanation of this Golob[10] states that the multiplicity of peritoneal attachments, as well as the complexity of structures in relation to the duodenum, offer a fertile field for the formation of embryological abnormalities. Opinions seem to differ in regard to the predominance of acquired diverticula and of the congenital type. The principal reasons for attributing diverticula to congenital defects are:—the condition has been found in infants, it may be multiple, and it may be associated with similar changes in other parts of

the alimentary tract. Odgers[28] and Lipschutz[21] report cases of duodenal diverticulosis in which multiple small diverticula were described in all three portions of the duodenum.

Etiology. The studies of Lewis and Thing[19], Falconer[8] and Tandler[36] all support the view that duodenal diverticula are congenital in nature. They represent abortive attempts at the formation of a supernumerary pancreas. Linsmayer[20] holds that they are congenital only in the sense that these pancreatic anlagen cause local defects in the musculature, and possibly an outpouching results from intestinal atony or an increase in the intraduodenal pressure.

Golos[10] and others report cases in which traction from without, as in gall-bladder and pancreatic disease with adhesions, may be responsible for the causation of diverticula.

The frequency with which duodenal diverticula occur in the region of the fold of Vater, Fleischman[9] believes, is due to an essential weakness at this point. Partial obstruction at the duodenojejunal junction as a cause of back pressure may result in the development of a duodenal diverticulum. Kaldor[14] reports atresia of the duodenum, with diverticula resulting.

Symptoms. There is no definite clinical picture that characterizes a duodenal diverticulum. The general symptomatology may resemble cholecystitis or cholelithiasis, duodenitis, pancreatic disease, gastric or duodenal ulceration, or even reflex gastric disturbances reflexed from a chronic appendicitis. Pendergrass[30] believes that the symptomatology of a duodenal diverticulum most commonly simulates that of cholecystitis, duodenitis or duodenal ulcer. It must be remembered, however, that many diverticula are not symptom-producing.

Pain, a common symptom, may vary from a slight ache to a severe colicky pain. It may recur after eating, but is usually relieved by food or alkali. There are usually long periods when the patient is entirely free from pain. Vomiting is rare. Eructations, nausea and heartburn are frequent complaints. Loss of appetite and weight are common.

Ohnell[29] reports 34 cases of duodenal diverticula in which pain was prominent in 85 per cent and vomiting or acid eructations in 14 per cent.

Complications. There are a few cases recorded in the literature in which serious results are connected with the presence of duodenal diverticula. Bauer[2] reported one case in which a duodenal diverticulum caused fatal intestinal obstruction. Monsanat[23] reports a case of acute perforation of a duodenal diverticulum. Malignant changes may occur as reported in a single case by Morrison and Feldman[26], where a primary carcinoma, situated in the mouth of a duodenal diverticulum, was found at autopsy. There were metastases to the liver and adjacent glands. Many have reported cases in which duodenal ulcers occur opposite to the mouth of a diverticulum. Huddy[13] reports a case of gangrenous duodenal diverticulitis. A rare case is cited by Korchov[15] in which a false diverticulum was formed by the perforation of a gall-bladder calculus into the duodenal wall. Calculi are not infrequently found in duodenal diverticula. Inflammatory changes often take place and are usually thought to be due to retention of food or foreign bodies in the pouch. These changes vary in extent, and adhesions are commonly found about the pouch at operation. Hemorrhage is considered to be a frequent complication.

Roentgenographic findings. The Roentgen diagnosis of a duodenal diverticulum depends upon the visualization of a localized paraduodenal sacculation. An accumulation of opaque medium adjacent to the duodenum and characteristic of a diverticulum is seen best immediately after the ingestion of a barium meal. Films are taken 4, 6, and 24 hours after the ingestion of a barium meal to determine the presence of retention in the diverticulum. Fluoroscopic examination in the various oblique views are routinely done, and give valuable information concerning the location, mobility, size and shape of the diverticulum, as well as the degree of gastric peristaltic activity. The films of the stomach and duodenum taken after fluoroscopy may show the dimensions of the orifice of the diverticulum, the presence of distension in the distal or proximate duodenum, and will more clearly outline the position and shape of the diverticulum. For completion, all cases showing Roentgen evidence of a duodenal diverticulum should be further examined by cholecystography. Some relation may be established between the duodenal deformity and the gall-bladder by filling the

stomach and duodenum with barium after obtaining an outline of the gall-bladder by means of biliary dye.

Differentiation. Gastro-intestinal roentgenographic examination is the primary agent in the diagnosis of duodenal diverticula. Opaque shadows, both outside and inside the gastro-intestinal tract, must be differentiated from barium-filled diverticula. These include those due to calcified mesenteric lymph-nodes, renal, biliary and pancreatic calculi, fecaliths, and ingested salts of bismuth, barium, or other opaque drugs. Perforation of a duodenal ulcer with the formation of a small pocket of opaque medium is occasionally observed, and must be differentiated from a duodenal diverticulum. It is very difficult to differentiate a diverticulum from a penetrating ulcer showing just a "fleck ulcer". Ratti[32] stresses an important point in differentiation by emphasizing the fact that extroflexions of the duodenal wall which originate from cicatrization of ulcers, may simulate diverticular sacculations. When the bulbus duodeni is deformed by an extensively scarred ulcer, extroflexions of a diverticular type may be produced and are called para-ulcerous diverticula or false diverticula.

The following two cases from our clinic are cited because they seem to illustrate the two general types of this condition; namely, a case of duodenal diverticulum with symptoms, and another without symptoms. The positive findings only are mentioned.

CASE 1. Negro, male. Age 24 years.

Chief Complaint: The patient was admitted to the medical clinic of the dispensary complaining of "pain in the stomach".

Present Illness: Prior to a week before admission he had enjoyed good health, when he developed a constant dull ache in the epigastrium. After eating, the pain became decidedly sharper for about one hour, and tended to radiate across to the right upper quadrant. After about an hour, the sharp pain disappeared, but a dull ache persisted. Two days before admission, he had an attack of sharp pain in the epigastrium. This lasted for about three or four hours, and "left his side sore." With these bouts of sharp pain he felt nauseated, but he never vomited.

Past History: This was negative, except for a history of inconstant slight pain in the upper abdomen for the past three months.

Physical Examination: Except for abdominal point tenderness at the midline in the epigastrium and slight tenderness in the right upper quadrant just below the costal margin, this was essentially negative.

Laboratory Findings: Urine examination negative. Blood and stood examinations were not done.

Clinical Impression: The vague abdominal symptoms were not considered suggestive of any particular abdominal condition. Peptic ulcer with an atypical history, as well as gall-bladder disease, were the two best possibilities. A routine gastro-intestinal roentgenographic examination was advised.

Roentgenographic Findings: Examination of the gastro-intestinal tract demonstrated the presence of a rather large pouch-like defect of the second portion of the duodenum, suggestive of a duodenal diverticulum. It measured approximately 2 x 3 cm. in two of its dimensions. Examination at the end of 6 hours showed a fleck of barium in the region of the second portion of the duodenum, presumably retention in the diverticulum. The head of the barium column was in the descending colon. Examination at the end of 24 hours demonstrated no evidence of diverticulosis or of infiltration of the colon. No barium was seen in the region of the duodenum. The gall-bladder was not examined. There was no roentgenographic evidence of a gastric or duodenal ulcer or of gastric malignancy.

Roentgenographic Impression: Diverticulum of the second portion of the duodenum.

Course: Hospitalization was advised for further study, but the patient refused. He was then followed in the dispensary, and was put on a six meal bland Sippy diet for one month. Calcium carbonate was also prescribed. At this time, the patient was still having a moderate amount of distress. Surgery was to be advised if the patient obtained no relief from medical treatment.

One week after medical treatment was started, the patient stated that he still had epigastric pain, but it was less severe. Some days he would be entirely free from pain. An "in-between" meal would cause a disappearance of the pain. He had experienced one bout of sharp pain radiating to the right back.

Two weeks after starting a dietary régime, the patient showed no definite improvement. He still had a rather constant gnawing pain in the right upper quadrant, which was often relieved for a short time by a feeding. Tincture of belladonna was prescribed.

Three weeks after starting treatment, the patient felt definitely improved. During the past week he had had only one day of gnawing pain, and it was not as constant as it had been before.

Four weeks after the initial treatment, he complained only of a slight gnawing feeling in the epigastrium, just before his "in-between meals" and before breakfast. This feeling was completely relieved by food. Exertion seemed to bring it on. The diet was continued, with the addition of cream for the patient had been losing weight.

During the next month the patient complained only of an occasional attack of pain, and these seemed to come on only with exertion. He was advised to exercise more, but not without having eaten.

Two months later, or four months after starting medical treatment, the patient appeared greatly improved. He rarely had epigastric pain, and when he did, it was immediately relieved by food. He had gained weight, and had returned to work. He still continued his dietary régime.

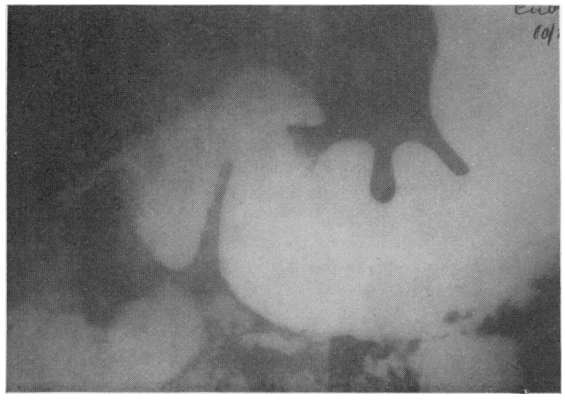

FIG. 1.

CASE I.

Diverticulum of the second portion of the duodenum. A six-hour barium retention was noted in the diverticulum.

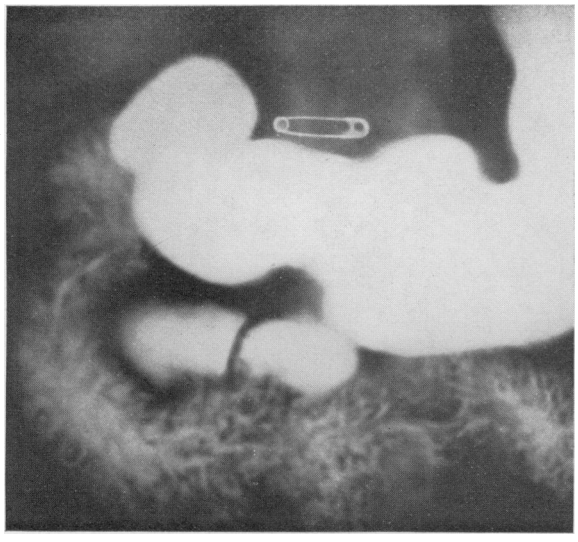

FIG. 2.

CASE II.

Diverticula of the third portion of the duodenum.

No six-hour retention was noted in the diverticula.

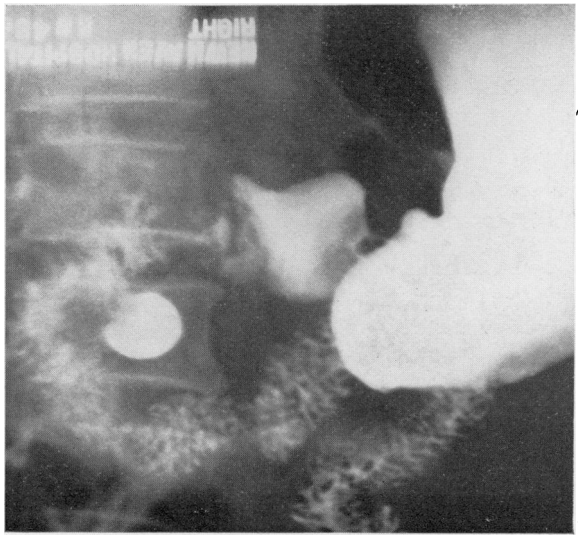

FIG. 3.

Diverticulum of the second portion of the duodenum. No six-hour retention.

CASE 2. White, Male. Age 48 years.

The patient was referred to the department of radiology for a routine gastro-intestinal examination, especially to rule out the presence of malignancy. He had no gastro-intestinal symptoms, but his brother had recently died, and the diagnosis of carcinoma of the cecum in the latter worried him considerably.

The past history was essentially negative. The patient had never complained of any sharp epigastric pain, and had always been in good health. The physical examination was negative.

Roentgenographic Findings: The radiographic examination of the esophagus and stomach was negative. There was a double pouch-like collection of barium just above and adjacent to the third portion of the duodenum, which suggested diverticula. Each measured approximately 3.5 x 2.5 cm. in diameter, and the mouths of each appeared wide. There was no point tenderness on deep palpation over this area, nor was there any retention of barium in the region of the stomach or duodenum at the 6-hour examination. The 24-hour examination and a barium enema were negative.

Impression: Diverticula of the third portion of the duodenum.

The patient has been seen repeatedly by his physician for six months since the accidental discovery of the duodenal diverticula, and he is still without symptoms.

Treatment. Theoretically, the ideal treatment is complete removal of the sac. As to whether this treatment should be advised in a given case or whether the patient should be treated medically depends upon the symptoms and the location of the diverticulum. If the symptoms necessitate early relief, operative excision of the diverticulum with invagination of the base is indicated. It is not within the scope of this paper to discuss various methods of surgical approach or technic. For a discussion of the pioneer work on the operative treatment of these conditions the reader is referred to Moore[24], Lewis[18], Ritchie[33] and MacLean[22]. MacLean describes a technic for the removal of a diverticulum embedded in the head of the pancreas or in the retroperitoneal space. Inability to find the diverticulum at operation does not necessarily prove that the diagnosis was incorrect, as several cases are on record where operation failed to disclose the condition but autopsy later revealed the sac in back of the pancreas or in an inaccessible location. Hartung[11] cites such a case. Medical treatment based on that for a duodenal ulcer is the usual conservative method employed. A diet which favors alkalinization is the most helpful in view of the fact that an inflammatory process is usually present in these cases. Belladonna is especially indicated

if the Roentgen examination reveals spasm of the pylorus along with the presence of a duodenal diverticulum.

CONCLUSIONS

1. Duodenal diverticula are more common than is assumed and, as a rule, remain symptomless and thus undetected until some inflammatory, mechanical or neoplastic complication leads to a Roentgen examination.

2. Prolonged retention of material in the diverticulum favors the possibility of diverticulitis.

3. There is no typical pathognomonic symptomatology, but the long duration of the disease and the persistence of pain in the epigastrium, with nausea, should suggest a possible duodenal diverticulum.

4. A majority of clinicians favor the more conservative medical treatment rather than surgical intervention.

REFERENCES.

[1] Andrews, E. W.: J. Am. Med. Assn., 1921, 77, 1309.
[2] Bauer: Wien. klin. Wchnschr., 1912, *23*, 879.
[3] Butler, P. F., and Ritvo, M.: Boston M. & S. J., 1925, *192*, 705.
[4] Case: Am. J. Roentgenol., 1916, June.
[5] Chomel: Hist. de l'Acad. roy. Par., 1710.
[6] Cole, L. G., and Roberts, D.: Surg. Gynec. & Obst., 1920, *31*, 376.
[7] Downes, W. A.: Ann. Surg., 1922, *76*, 43.
[8] Falconer: Lancet, 1907, *i*, 1296.
[9] Fleischman: Leichenoeffnungen. Erlanger, 1815.
[10] Golob, M.: Am. J. Roentgenol., 1928, *20*, 24.
[11] Hartung, A.: Radiology, 1925, *4*, 308.
[12] Herschel and Good: Wien. med. Wchnschr., 1880.
[13] Huddy, G. P. B.: Lancet, 1923, *ii*, 327.
[14] Kaldor: Ann. Surg., 1929, *89*, 6.
[15] Korchov, V.: Zentralbl. f. Chir., 1928, *55*, 2955.
[16] Larimore, J. W., and Graham, E. A.: Surg. Gynec. & Obst., 1927, *45*, 257.
[17] LeTulle: Bull. et mém. Anat., Paris, 1898.
[18] Lewis, D.: J. Am. Med. Assn., 1921, *76*, 783.
[19] Lewis and Thing: Am. J. Anat., 1908, *8*, 505.
[20] Linsmayer: Verhandl. d. deutsch. path. Gesellsch., 1914, 445.
[21] Lipschutz, E. W.: Am. J. Med. Sc., 1925, *170*, 53.
[22] MacLean, N. J.: Ann. Surg., 1927, *85*, 73.
[23] Monsanat, K. W.: Brit. J. Surg., 1926, *14*, 179.
[24] Moore, E. C.: Arch. Surg., 1920, *1*, 513.

[25] Morgagni: Trad. ital. Firenzi, 1839.
[26] Morrison, T. H., and Feldman, M.: Ann. Clin. Med., 1925, *4*, 403.
[27] Nagel, G. W.: Arch. Surg., 1925, *11*, 529.
[28] Odgers, P. N.: Brit. J. Surg., 1930, *17*, 592.
[29] Ohnell, H.: Arch. f. Verdauungskr., 1923, *31*, 127.
[30] Pendergrass, R. C.: Am. J. Surg., 1928, *5*, 491.
[31] Penhallow, D. P.: J. Am. Med. Assn., 1923, *80*, 1372.
[32] Ratti, A.: Radiol. med., 1928, *15*, 1111.
[33] Ritchie, H. P., and McWhorther, G. L.: Surg. Gynec. & Obst., 1917, *25*, 485.
[34] Roth: Virchow's Arch. f. path. Anat., 1872.
[35] Seippel: Zurich, 1895.
[36] Tandler: J. Morphology, 1902, *24*, 187.